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Nutrient Utilization in Buffalo Bulls Fed Crop Residue Based Complete Rations Supplemented With or Without Yeast Culture

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Abstract

The present investigation was carried out to study the effect of feeding crop residue based complete rations supplemented with and without live yeast culture on nutrient utilization in buffalo bulls. In 4 x 4 LSD, four graded Murrah buffalo bulls (6 years; 330.7±30.63 kg) were randomly allotted to four dietary treatments viz., maize stover based complete ration (T_1), T_1 supplemented with yeast culture (T_2), jowar stover based complete rations (T_3) and T_3 supplemented with yeast culture (T_4). The complete rations were prepared by mixing maize or jowar stover and concentrate mixture in 60:40 proportions. The live yeast culture containing *Saccharomyces cerevisiae* at 6 x 10^{10} cfu/g was supplemented at the recommended level of 10 g/animal/day. Results revealed that the dry matter intake expressed as kg/d or as % of BW was similar among the four dietary treatments. The digestibility co-efficients of dry matter, organic matter, crude protein, ether extract, crude fibre, neutral detergent fiber, acid detergent fiber, hemi-cellulose, cellulose ($P<0.01$) and nitrogen-free extract ($P<0.05$) were higher in T_2 when compared to others. All the buffalo bulls were in positive nitrogen, calcium and phosphorus balance. The digestible crude protein and total digestible nutrient content expressed as % in the diet consumed or kg/d was higher ($P<0.01$) in T_2 as compared to other treatments. Thus, it is concluded that the performance of animals was better on maize stover based complete ration supplemented with live yeast culture (T_2) as evidenced by higher plane of nutrition.

Keywords: Complete rations; DMI; Nutrient utilization; Yeast culture

Introduction

Agricultural crop residues such as cereal straws are rich sources of carbohydrates thus, representing a large potential source of dietary energy for ruminants. It is well recognized that rice straw, wheat straw, maize stover and jowar stover are poor in nutritive value because of their low nitrogen and high fibre content. However, incorporation of these crop residues in complete rations improves both palatability and nutrient utilization (Venkateswarlu *et al*., 2013). In recent years, yeast culture has been used to improve the nutritive value and utilization efficiency of low quality roughages. Yeast culture (*Saccharomyces cerevisiae*) has been extensively used as a dietary supplement in ruminants. The benefits associated with *S. cerevisiae* include increased dry matter intake (DMI) (Kishan Kumar and Ramana, 2008), increased growth rates (Srinivas Kumar *et al*., 2010), improved dry matter (DM) and neutral detergent fiber (NDF) digestibility (Reddy and Bhima, 2003) and increased milk yield (Wohlt *et al*., 1998). Hence, the present experiment was designed to study the effect of supplementation of yeast culture (*Saccharomyces cerevisiae*) on nutrient utilization in buffalo bulls fed crop residue based complete rations.

Materials and methods

The study was conducted at NTR College of Veterinary Science, Gannavaram, Andhra Pradesh,

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India from 1st August, 2012 to 23rd October, 2012. In 4 x 4 LSD, four graded Murrah buffalo bulls (6 years; 330.7±30.63 kg) were randomly allotted to four dietary treatments viz., maize stover based complete ration (T_1), T_1 supplemented with yeast culture (T_2), jowar stover based complete rations (T_3) and T_3 supplemented with yeast culture (T_4). The complete rations were prepared by mixing either maize or jowar stover and concentrate in 60:40 proportions. The live yeast culture containing *Saccharomyces cerevisiae* at 6 x 10^{10} cfu/g was supplemented at the recommended level of 10 g/animal/day. All the bulls were offered 6.5 kg each of respective diets (T_1, T_2, T_3 and T_4) to meet the maintenance requirements (ICAR, 1998). Ad libitum fresh, clean drinking water was offered to the bulls all throughout the experimental period. The ingredient composition of complete rations was furnished in Table1.

Each period of a Latin square consisted of a 14 days preliminary period and 7 days collection period. On the 13th day of the preliminary period, the bulls were shifted to the metabolism stalls for adaptation where there was provision to collect faeces and urine separately. The metabolism stalls were

Table 1. Ingredient composition of complete rations fed to buffalo bulls during the trial

Ingredient	T_1	T_3
Maize stover	60.0	-
Jowar stover	-	60.0
Maize grain	6.0	4.0
DORB	10.2	9.9
Cotton seed cake	17.5	19.8
Sunflower cake	4.8	4.8
Mineral mixture	1.0	1.0
Salt	0.5	0.5
Sub total	100	100

Table 2. Chemical composition of crop residues and crop residue based complete rations fed to buffalo bulls during the trial

Nutrient	Maize stover	Jowar stover	Maize stover based complete ration	Jowar stover based complete ration
Dry matter	92.17	92.19	92.49	93.85
Organic matter	92.38	92.11	90.77	90.85
Total ash	7.615	7.88	9.24	9.15
Crude protein	4.80	3.46	13.54	13.43
Ether extract	1.262	1.39	1.16	1.26
Crude fibre	40.91	42.69	31.94	34.09
Nitrogen free extract	45.40	44.57	43.72	41.85
Neutral Detergent Fibre	73.25	71.58	66.88	62.29
Acid Detergent Fibre	54.42	57.16	42.06	44.38
Acid Detergent Lignin	6.042	8.975	5.77	6.812
Hemi-cellulose	18.83	14.42	23.82	17.91
Cellulose	42.93	43.13	36.16	36.84
Silica	1.60	1.97	0.55	0.93
Calcium (%)	0.43	0.46	0.92	0.91
Phosphorus (%)	0.18	0.24	0.59	0.61

designed in such a manner that urine as and when voided will be collected in container kept in the ground. The buffalo bulls were fed respective complete rations at 9.00 AM and 3.00 PM all through the experimental period. During the metabolism trial, the amount of feed offered, faeces and urine voided were recorded. Daily representative samples of feed, faeces and urine were collected and pooled animal wise. The samples were analyzed for proximate constituents (AOAC, 2007) and fibre fractions (Van Soest *et al*., 1991). Estimation of calcium (Ca) and phosphorous (P) in feed and faeces was done as per Talapatra *et al* (1940) and in urine samples was done according to the methods described by Ferro and Ham (1957) and Fiske and Subba Row (1925), respectively.

The data was subjected to statistical analysis as per the procedures suggested by Snedecor and Cochran (1989) using SPSS version 17.0.

Results

The chemical composition of crop residues and crop residue based complete rations and the effect of feeding these crop residues based complete rations supplemented with or without yeast culture on nutrient utilization in buffalo bulls were presented in Tables 2, 3 and 4.

The digestibility (%) of DM, organic matter (OM), crude protein (CP), ether extract (EE), crude fibre (CF) and cell-wall constituents ($P<0.01$) and nitrogen-free extract (NFE) ($P<0.05$) were higher in bulls fed T_2 as compared to T_1, T_3 or T_4 (Table 3). The percent digestible crude protein (DCP) and total digestible nutrient (TDN) contents in the diet were higher ($P<0.01$) in bulls fed T_2 when compared to other dietary treatments (Table 3). However, the DCP and TDN intakes ($g/kg^{W0.75}$) were similar among the four dietary treatments. Simi-

Table 3. Effect of yeast culture supplementation on nutrient intake, digestibility and plane of nutrition in buffalo bulls

Particulars	T_1	T_2	T_3	T_4	SEM
Dry matter intake					
Kg / d	6.01	6.01	6.10	6.10	
Kg / 100 kg BW	1.87	1.86	1.90	1.89	
g / kg $^{W0.75}$	78.87	78.79	80.07	80.04	2.743
Digestibility (%)					
Dry matter**	57.41^{c}	60.53^{d}	52.97^{a}	55.69^{b}	0.747
Organic matter**	60.35^{c}	63.30^{d}	55.27^{a}	58.24^{b}	0.810
Crude protein**	66.71^{b}	69.78^{c}	64.06^{a}	66.02^{b}	0.585
Ether extract**	55.72^{b}	57.86^{c}	53.79^{a}	54.89^{ab}	0.445
Crude fibre**	51.74^{c}	56.43^{d}	45.29^{a}	49.67^{b}	1.050
Nitrogen free extract*	64.74^{bc}	66.36^{c}	60.30^{a}	62.60^{ab}	0.763
Neutral detergent fibre**	54.92^{c}	58.82^{d}	48.65^{a}	52.44^{b}	0.978
Acid detergent fibre**	49.56^{b}	52.46^{c}	44.44^{a}	48.78^{b}	0.775
Hemi cellulose**	62.49^{b}	66.89^{c}	59.09^{a}	61.51^{b}	0.798
Cellulose**	56.06^{b}	60.11^{c}	51.15^{a}	54.77^{b}	0.863
Nutrient intake (g / $kg^{W0.75}$)					
DCP intake	7.33	7.67	6.90	7.12	0.275
TDN intake	43.85	46.02	40.74	42.92	1.690
Plane of nutrients					
DCP (%)**	9.30^{c}	9.73^{d}	8.61^{a}	8.87^{b}	0.118
TDN (%)**	55.58^{c}	58.27^{d}	50.81^{a}	53.56^{b}	0.753

Values in same row with different superscripts differ significantly *($P<0.05$) ** ($P<0.01$)

Table 4. Nitrogen, Calcium and Phosphorus utilization in buffalo bulls fed complete rations supplemented with and without yeast culture

Particulars	T_1	T_2	T_3	T_4	SEM
N intake g/d	134.08	134.08	131.09	131.09	
N outgo, g/d					
Faeces**	48.24^{b}	46.85^{a}	50.83^{c}	47.43^{a}	0.405
Urine**	20.94^{b}	18.66^{a}	23.96^{d}	21.88^{c}	0.498
N retention					
g/d**	64.90^{c}	68.57^{d}	56.30^{a}	61.78^{b}	1.171
% intake**	48.40^{c}	51.14^{d}	42.95^{a}	47.13^{b}	0.770
% absorbed**	75.61^{c}	78.60^{d}	70.15^{a}	73.85^{b}	0.797
Ca intake g/d	55.03	55.03	55.38	55.38	
Ca outgo, g/d					
Faeces**	33.47^{b}	31.90^{a}	36.35^{d}	34.93^{c}	0.442
Urine^{NS}	4.74	4.38	4.75	4.67	0.073
Ca retention					
g/d**	16.82^{c}	18.76^{d}	14.28^{a}	15.78^{b}	0.437
% intake**	30.57^{c}	34.08^{d}	25.78^{a}	28.49^{b}	0.811
% absorbed**	78.01^{b}	81.07^{c}	75.03^{a}	77.15^{b}	0.636
P intake g/d	35.32	35.32	37.08	37.08	
P outgo, g/d					
Faeces**	13.59^{a}	13.51^{a}	16.25^{c}	15.27^{b}	0.322
Urine**	4.96^{b}	4.38^{a}	5.58^{c}	5.32^{bc}	0.134
Phosphorus retention					
g/d**	16.77^{bc}	17.43^{c}	15.26^{a}	16.49^{b}	0.234
% intake**	47.28^{c}	49.36^{c}	41.14^{a}	44.47^{b}	0.864
% absorbed**	77.16^{b}	79.93^{c}	73.22^{a}	75.62^{b}	0.696

Values in same row with different superscripts differ significantly ** (P<0.01)

larly, the retentions of nitrogen (N), calcium (Ca) and phosphorus (P) expressed either as g/d or as % absorbed were higher (P<0.01) in T_2 when compared to T_1, T_3 or T_4 (Table 4).

Discussion

The composition of crop residues and crop residue based complete rations fed to buffalo bulls during the trial were presented in Table 2. Chemical analysis indicated that maize stover and maize stover based complete ration contained more soluble carbohydrates and low acid detergent fiber (ADF) and acid detergent lignin contents when compared to jowar stover or jowar stover based complete ration. Venkateswarlu *et al*. (2013) also reported similar findings. The DMI expressed as kg/d or as % of BW was similar (P>0.05) among the dietary treatments (Table 3). The average DMI of buffalo bulls fed either maize or jowar stover complete rations supplemented with and without yeast culture were comparable to the values recommended by ICAR (1998) and Kearl (1982) standards. This indicated that the diets are palatable and that the blending of crop residues with concentrates had not affected the palatability.

The apparent digestibility (%) of DM, OM, CP, ether extract (EE), CF and cell-wall constituents (P<0.01) and NFE (P<0.05) were higher in bulls fed maize stover based complete ration (T_1) compared to jowar stover based complete rations (T_3) (Table 3). Venkateswarlu *et al*. (2013) also reported increased digestibility of nutrients in bulls fed maize stover based complete rations compared to either jowar stover, red gram straw or black gram straw based complete ration. Further, the present study indicated that the digestibility of nutrients in bulls fed both maize and jowar stover based complete rations are within the normal range. These results support the hypothesis that complete feeds provide uniform supply of nutrients at regular interval, which helps to maintain steady rumen environment resulting in better digestibility of nutrients (Talpada *et al*., 2002). Further, supplementation of yeast culture to either maize stover (T_2) or jowar stover (T_4) based complete rations increased (P<0.01) the digestibility of DM, OM, CP, EE, CF, NDF, ADF, hemi-cellulose, cellulose (P<0.01) and

NFE (P<0.05) in bulls compared to those fed respective crop residue based un-supplemented complete ration (Table 3). This increased digestibility observed on supplementation of yeast culture in the complete ration could be due to increased rate of fibre breakdown (Dawson *et al*., 1990), increased protozoal population (Plata *et al*., 1994) or due to increased bacterial numbers in the rumen leading to increased rate of fibre degradation and increased flow of microbial protein from the rumen (Beauchemin *et al*., 2006). Reddy and Bhima (2003) in Deoni bull calves, Aasha Rekha *et al*. (2005) and Mahender *et al*. (2006) in Nellore rams, Kishan Kumar and Ramana (2008) in calves and Srinivas Kumar *et al*. (2010) in buffalo bull calves reported improved digestibility of nutrients on yeast culture supplemented diets.

The percent of DCP and TDN contents were higher (P<0.01) in bulls fed T_1 as compared to T_3 (Table 3). Further, the DCP and TDN (%) content of the diet increased (P<0.01) with yeast culture supplementation irrespective of the crop residue reflecting the increased digestibility of nutrients in the yeast culture supplemented group of bulls. Reddy and Bhima (2003) and Mahender *et al*. (2006) reported improved DCP and TDN content of diets supplemented with yeast culture. Further, it is observed that all dietary treatments recorded higher DCP and TDN intakes ($g/kg^{W0.75}$) when compared to that recommended by ICAR (1998) and Kearl (1982) standards.

The retentions of N, Ca and P expressed either as g/d or as % intake or as % absorbed were higher (P<0.01) in T_1 when compared to T_3 (Table 4). Further, supplementation of yeast culture in complete diets significantly increased (P<0.01) the N retention expressed as either g/d or as % intake or as % absorbed. This might be due to optimum utilization of dietary nitrogen by microbes due to matching energy supply in the diet. Similarly, the retentions of Ca and P also increased with supplementation of yeast culture in the diet. Mahender *et al*. (2006) reported increased (P<0.01) N, Ca and P retentions (g/d) in Nellore rams fed yeast based complete diet while Patil *et al*. (2009) reported no significant improvement in sheep fed yeast based complete diets.

Conclusion

The present study indicated that maize stover based complete ration is utilized better when compared to jowar stover based complete ration. Further, the performance of animals increased with supplementation of yeast culture in the diet irrespective of the crop residue as evidenced by higher plane of nutrition.

References

AOAC, 2007. Official methods of Analysis (18th ed.). Association of Official. Analytical chemists, Washington DC.

Aasha Rekha, N., Rama Prasad, J., Ramana, J.V., Ravi, A., 2006. Evaluation of ground nut haulms based complete rations with or without yeast culture in sheep. Indian Journal of Animal Nutrition 23(1), 1-4.

Beauchemin, K.A., Krehbiel, C.R., Newbold, C.J., 2006. Enzymes, bacterial direct-fed microbials and yeast: principles for use in ruminant nutrition. In: Biology of Nutrition in Growing Animals, Edited by Mosenthin R., Zentek J., Żebrowska, T. ISBN: 978-0-444-51232-1. Elsevier Ltd pp. 251-284.

Dawson, K.A., Newman, K.E., Boling, J.A., 1990. Effects of microbial supplements containing yeast and lactobacilli on roughage fed ruminal microbial activities. Journal of Animal Science 68, 3392-3398.

Ferro, P.V., Ham, A.B., 1957. A simple spectrophotometric method for the determination of calcium. American Journal of Clinical Pathology 28, 208.

Fiske, C.H., Subba Row, Y., 1925. A calorimetric method for determination of Phosphorus. Journal of Biological Chemistry 66, 375.

ICAR., 1998. Nutrient requirements of livestock and Poultry, New Delhi.

Kearl, L.C., 1982. Nutritive requirements of ruminants in developing countries. International feedstuffs institute, Utah Agricultural Experimental Station, Utah State University, Logan, USA.

Kishan Kumar, M., Ramana, D.B.V., 2008. Effect of supplementation of yeast culture to calves fed with complete diet. The Indian Veterinary Journal 85, 667 – 669.

Srinivas Kumar, D., Rama Prasad, J., Raghava Rao, E., Sarjan Rao, K., 2011. Effect of yeast culture supplementation on nutrient utilization in Graded Murrah buffalo bull calves. Livestock Research for Rural Development 22 (7), Article#125.

Mahender, M., Prasad, V.L.K., Reddy, G.V.N., 2006. Effect of yeast culture on growth and nutrient utilization in Nellore lambs. Indian Journal of Animal Nutrition 23(1), 10-13.

Patil, C., Ramachandra, B., Suresh, B.N., Madhav Prasad, C.B., Shetter, V.B., 2009. Effect of complete diet with or without yeast culture in sheep. Indian Journal of Animal Nutrition 27(1), 81-84.

Plata, P.F., Mendoza, M.G.D., Barcena-Gama, J.R., Gonzalez, M.S., 1994. Effect of a yeast culture (*Saccharomyces cerevisiae*) on neutral detergent fiber digestion in steer fed oat straw based diets. Animal Feed Science and Technology 49, 203-210.

Reddy, G.V.N., Bhima, B., 2003. Effect of yeast culture based diet on growth and nutrient utilization in Deoni bull calves. Indian Journal of Animal Nutrition 20 (1), 101-104.

Snedecor, C.W., Cochran, W.G., 1994. Statistical methods (6th edition). Iowa State University. Press Anes, USA.

SPSS., 2008. Statistical packages for Social Sciences, Version 17.0, SPSS Inc., Illinois, USA.

Talapada, P.M., Pandya, P.R., Patel, G.R., Patel, D.C., Desai, M., 2002. Utilization of complete feed using Prosopis juliflora pods as a ration of growing crossbred calves. Indian Journal of Animal Nutrition 19 (1), 1-6.

Talapatra, S.K., Ray, S.C., Sen, K.C., 1940. The analysis of mineral constituents in biological materials. Part-I. Estimation of Phosphorus, chlorine, calcium, magnesium, sodium and potassium in foodstuffs. Indian Journal of veterinary Science and Animal husbandry 10, 243.

Van Soest, P.J., Robertson, J.B., Lewis, B.A., 1991. Methods for dietary fiber, neutral detergent fiber, and non-starch polysaccharides in relation to animal nutrition. Journal of Dairy Science 74, 3583-3597.

Venkateswarlu, S., Srinivas Kumar, D., Narendranath, D., 2013. Nutrient utilization in buffalo bulls fed crop residue based complete rations. Online Journal of Animal and Feed Research 3 (2), 101-105.

Wohlt, J.E., Corcione, T.T., Zajac, P.K., 1998. Effect of yeast on feed intake and performance of cows fed diets based on corn silage during early lactation. Journal of Dairy Science 81, 1345-1352.